THE HEALTH IMPACT OF URBAN POOR HOUSING AND ENVIRONMENTAL CONDITIONS

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I. INTRODUCTION

If health were considered a product, medical care would simply be one input used in producing it. Unfortunately, the economics literature generally ignores this. Research just focuses on medical care, medical insurance, and the workings of its markets. But as Arrow (1963) himself admits, "particularly at low levels of income, other commodities such as nutrition, shelter, clothing, and sanitation may be much more significant" than medical care as causal factors in health.

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The attempt made here to broaden research on the determination of health begins with housing. How exactly does housing affect households health status? But to put this question in perspective, another is raised. How does housing interact with other health inputs? Or what trade-offs exist between housing and medical care, housing and education, and housing and nutrition? It is hoped that from this paper, other efforts towards the resolution of these questions shall be initiated.

If one carefully thinks about reports by health authorities on the major diseases that pervade among the poor, particularly those in city centers, one almost cannot escape associating these with the housing and environmental conditions that prevail in communities where they reside. Consider the following correspondences.

The incidence of diseases due to contaminated water such as typhoid, hepatitis, cholera, dysenteries, and diarrhea are strongly affected by water supply to the house, safe water storage and water supply infrastructure. Toilets, latrines, septic tanks, sewage connections and drainage infrastructure are likewise strong determinants of diseases due to contaminated water and food, and contact with disease vectors due to problems of human waste disposal. The incidence of respiratory diseases, stress, and household accidents due to overcrowding are also determined by such housing components as number of rooms, floor space, lot size, and the area occupied by the neighborhood.

If these linkages between housing components and the incidence of diseases can be established and quantified, it may be possible for housing programs, especially those directed at urban poor communities, to emphasize components that generate the greatest effects. Eventually, diseases prevented by the introduction of well-calibrated health concerns into housing programs and policies should free the resources the public allocated for its cure.

II. FRAMEWORK

Everyone would agree that quality of shelter and its immediate environment somehow affect the health status of its dwellers. Epidemiologically, certain aspects of the home environment are believed to cause or enhance the incidence of specific diseases. Overcrowding or the lack of living space raises the risk of respiratory illness. Contaminated water supply, unsanitary human and household waste disposal systems, and the presence of disease vectors are among the common causes of gastro-intestinal problems, skin ailments, and infectious diseases.

However, evidences to establish the various strands that weave the housing-health link are weak and sometimes conflicting. Analytical and empirical methodological difficulties prevent the link from being properly defined and measured. Take, for example, studies that attempt to determine the effects of overcrowding on the incidence of tuberculosis. The three most basic frameworks used in these studies are schematically presented as follows:

```
1)   poverty  ------ overcrowding ------ tuberculosis

              /------ overcrowding ------ tuberculosis
2)   poverty
              \------------------------- tuberculosis

              /------ overcrowding
3)   poverty
              \------ tuberculosis
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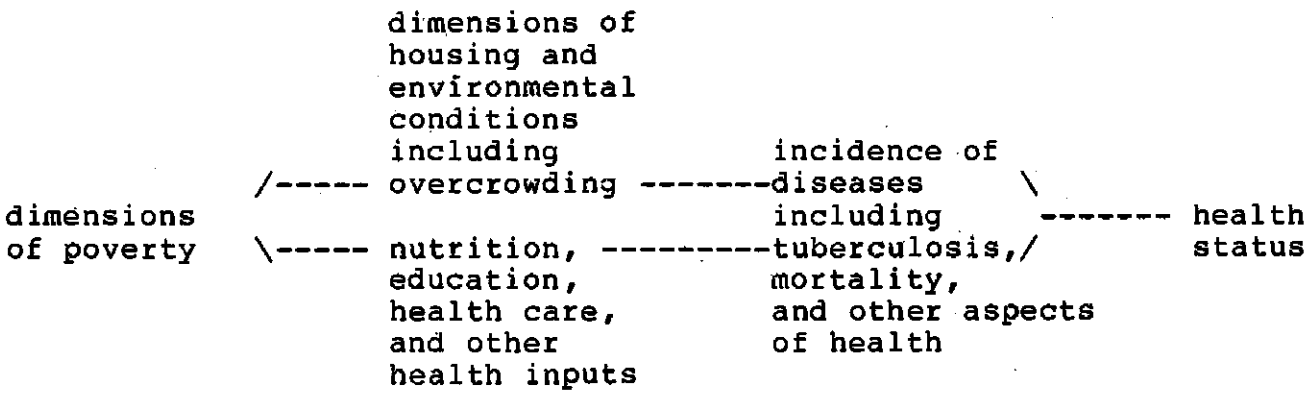
Model 1 presents a unilinear deterministic relationship among poverty, overcrowding and the incidence of tuberculosis. Obviously, the model fails to consider other factors affecting the individual's susceptibility to the disease, such as extent of preventive care and job or worksite conditions.

Model 3, on the other hand, goes to the opposite extreme by denying whatever causal relationships that exist between overcrowding and the incidence of tuberculosis. Determination of both are reduced to the state of poverty experienced by the individual or household.

Model 2 is a much better formulation since it accommodates for the fact that the incidence of respiratory illness cannot be blamed on housing and environmental conditions alone. In doing so, the model is then capable of discerning what is due to housing and what is not. However, it remains severely limited because (1) overcrowding may have effects on health other than the incidence of respiratory illness, and (2) it ignores trade-offs, complementations and substitutions among various health inputs.

A more complete model must be able to overcome these limitations. First of all, it should be able to evaluate the effects of housing, including its various components, on the overall household health status. While it is important to link specific housing and environmental components with specific diseases, the model should be able to capture the total effect on health. Secondly, the model should be able to determine what trade-offs exist among the various health inputs. The schema presented in the next page describes such a model.



This framework needs to be formally developed in a way compatible with quantitative analysis. In what follows, a formal model that builds upon this is presented.

Consider the decisions made by a representative household on consumption, health and housing, given a fixed income over a period of time, T. During that period, the household faces two possible states of health: sick or not sick. The household perceives the probability that at least one member falls ill in T to be equal to P (the probability that all household members are of perfect health during T is, therefore, equal to (1-P).

Supposing no one household member gets sick, the household maximizes a standard utility function, U^N (Z, H) where Z is a consumption composite and H is housing services. It is assumed that dU^N / dZ, $dU^N / dH > 0$, and d^2U^N / dZ^2, $d^2U^N / dH^2 \leq 0$. In words, utility increases with consumption and housing services and, on the margin, the additional utility derived from consumption and housing services diminishes.

Under the state of full health, the utility defined earlier is constrained by a given income, Y^N. This amount is spent on consumption, used here as the numeraire, housing, and preventive health services. Formally, $Y^N = Z + rH + vM^P$ where r is the unit price of housing services and v is the unit price of preventive medical care.

If at least one household member falls ill during during T, a period, I, is spent recovering from the illness, and the remainder, T-I, is spent with full health. The formulation here abstracts from possible permanent but nonfatal dysfunctions. During the period or illness episode I, the household is supposed to maximize the utility function U^S (Z^S, H^S) where Z^S and H^S are equal to Z/(1+d) and H/(1+d), respectively. 1/(1+d) is the discount factor for debility and discomfort. This parameter accommodates the notion that one derives much less enjoyment of being in a fully-furnished room draining an ice cold bottle of beer while battling a bout of influenza. It is similarly assumed that dU^S / dZ^S /, $dU^S / dH^S > 0$, and d^2U^S / dZ^{S2}, $d^2U^S / dH^{S2} \leq 0$.

The expected utility from consumption and housing over the period T may be defined formally as

$$P\ [\ I\ U^S\ (\ Z^S,\ H^S\ )\ +\ (T-I)\ U^N\ (\ Z,\ H\ )\ ]$$

$$+\ \ (1-P)\ [\ T\ \ U^N\ (\ Z,\ H\ )\ ]. \qquad (1)$$

There are four functional relationships that are vital to the model presented here. The first relationship defines what goes into the consumption composite,

$$Z = Z\ (z_1, \ldots\ldots, z_n) \qquad (2)$$

where z_i is the ith specific consumption commodity. The set Z might be specified to include food items, clothing, education and leisure. It is assumed here that Z is increasing with respect to the Z_is.

Following standard application of the hedonic price hypothesis on demand for housing, the following relationship is specified,

$$H = H\ (h_1, \ldots., h_n) \qquad (3)$$

where h_i is the ith component from which housing services are derived. These components may be specified to include the structure of the dwelling unit, kitchen and toilet facilities, household utilities, number of rooms, floor space and residential location. It is likewise assumed here that H is increasing with respect to the h_is.

The probability of illness, P, is assumed here to be a decreasing function of the preventive care components of Z, H, and medical care, M^P. The relationship may be presented as

$$P = P\ (Z,\ H,\ M^P) \qquad (4)$$

where dP/dZ, dP/dH, $dP/dM^P < \emptyset$ and d^2P/dZ^2, d^2P/dH^2, $d^2P/dM^{P2} < \emptyset$.

While preventive care components help determine the risk of falling ill, curative care components of housing, consumption, and medical care determine the rate at which household members recover from illness. Hence,

$$I = I\ (Z^S,\ H^S,\ M^C) \qquad (5)$$

where dI/DZ^S, dI/DH^S, $dI/dM^C < \emptyset$ and d^2I/dZ^{S2}, d^2I/dH^{S2}, $d^2I/dM^{C2} < \emptyset$.

The income resources the household will have for consumption and housing will obviously depend on its state of health. If at least one member is sick the household budget will be

$$Y^S = Z + rH + qM^C \qquad (6)$$

where r is the rental price of housing, and q is the price per unit of curative medical care. Z is picked as the numeraire.

Should the household remain healthy throughout T, the income constraint may be written as

$$Y^N = Z + rH + vM^P \qquad (7)$$

where v is the price of preventive medical care.

In (6) and (7), it is assumed that the household uses the entire sets of Z and H regardless of the state of health. The only effect of illness is that utility derived from Z and H is discounted by (1+d).

The household allocation problem can therefore be presented as the maximization of equation (1) subject to the constraints presented in (6) and (7), and given the functional relationships described in (2), (3), (4), and (5). Based on this maximization problem, the household health status may be represented as

$$S = S(I^*, P^*), \qquad (8)$$

where I^* and P^* are functions of the optimal levels for housing, consumption, and medical care. The index, S, of the household's health status is determined by two variables; one reflecting the time required for household members to recover from illness, and the other reflecting the household's health risks.

In equilibrium, the illness episode, I, and the risk of illness, P, are partly determined by the household's optimal demand levels for both the curative and preventive care components of consumption, housing, and medical care. Hence, the health status index may be rewritten as

$$S = S(Z^S, Z, H^S, H, M^C, M^P, \Omega), \qquad (9)$$

where Ω is a vector of other exogenous variables.

Therefore, the housing-health link may be derived from (9) as

$$dS/dH = dS/dH^S + dS/dSH. \qquad (10)$$

In estimating the abstract relationship described by equation (1Ø), a household health status index need to be constructed following equation (8). Several indices have been deviced and proposed but, in general, these are either too limited or abstract for practical use.

Instead, a health status index is developed based on respondents' own valuation. The subjective judgements made by respondents on household health status are then tested against more objective and observable data on various health components including mortality, morbidity, and nonfatal physical dysfunctions. The health status index is estimated using a logit model with the following general specification

$$Pr(V) = \log\left[\frac{Pr(V = 1)}{1 - Pr(V = 1)}\right] = b_1 + b_2 s_2 + \ldots + b_x s_x, \quad (11)$$

where

$$V = \begin{cases} 1 \text{ if the household is deemed healthy} \\ Ø, \text{ otherwise.} \end{cases}$$

The variables $s_1, \ldots, s_x$ stand for the various observable components of household health. The estimated values for the logit equation specified above will then be used as the overall health index.

An overall index for housing and environmental condition is similarly constructed. The fitted values are generated by regressing either enumerator or respondent subjective valuation of actual housing and environmental conditions. The index constructed on the basis of enumerator valuation is estimated by the following logit model

$$Pr(D) = \log\left[\frac{Pr(D = 1)}{1 - Pr(D = 1)}\right] = a_1 + a_2 h_2 + \ldots + a_n h_n, \quad (12)$$

where

$$D = \begin{cases} 1 \text{ if the home environment is well maintained} \\ Ø, \text{ otherwise.} \end{cases}$$

The variables $h_1, \ldots, h_n$ are the objective conditions of specific housing and environmental components.

After generating the health index, the determination of household health is estimated using a linear regression model with the following general specification,

$$Pr(V)^{*} = f(DEM, EXP_N, EXP_M, HSNG, COMM), \quad (13)$$

where $Pr(V)^{*}$ is the estimated household health index, DEM is a vector of relevant demographic variables, EXP_N is a vector of expenditures on nonmedical care health inputs, EXP_M is a vector of expenditures on medical care, HSNG is the housing condition index, and COMM is a vector of health inputs provided at the community level.

Finally, to determine the health effects of specific housing and environmental characteristics, the following specification is estimated.

$$Pr(V)^{*} = g(STRC, FCLTS, AMNTS, HZRDS, NBRHD), \quad (14)$$

where STRC is a vector of dwelling structural characteristics, FCLTS are indicators of quality of housing facilities, AMNTS are variables on the existence of public amenities, HZRDS are measures of the presence of hazards in the home environment, and NBRHD is a vector of other neighborhood characteristics.

To test whether the housing market reflects health concerns, a model designed to determine the implicit prices of specific housing characteristics is estimated. The general specification is as follows

$$RENT = r(STRC, FCLTS, AMNTS, HZRDS, NBRHD), \quad (15)$$

where RENT stands for the rental value of the dwelling. The results of (14) is then to be compared with that of (15). If these coincide, it may be said that health concerns in housing are adequately reflected by the market.

III. RESULTS

A. Health Status Indices

Two health indices are estimated; one for the entire household, and another one for children. The regression results are presented in Tables 1 and 2. In general, these suggest that respondent valuation of health status is consistent with more objective and observable specific health indicators. The frequencies of actual vs. predicted outcomes support this statement.

The dummy for city (CITY = 0 for Manila and = 1 for Cebu) is not found to be statistically significant. This result implies that respondents from both cities gave comparable assessments of household health. On the other hand, the dummy on household type (HHTYPE = 0 for urban nonpoor and = 1 for urban poor) it shown to significantly influence respondent valuation.

Table 1

Dependent variable	OWN VALUATION OF HH HEALTH
Log-Likelihood	-903.98
Restricted (Slopes=0) Log-L.	-992.91
Chi-Squared (17).....	177.86
Significance Level.....	.32173E-13

Variable	Coefficient	Std. Error	T-ratio	(Sig. lvl)
INTERCEPT	1.96037	.3018	6.495	(.00000)
AVE LENGTH OF SICKNESS--HHMEN	.103210E-02	.1358E-02	.760	(.44719)
EXTENT OF DEBILITY (1ST CASE)	-.267643E-01	.3736E-01	-.716	(.47379)
HOW ILLNESS CONTRACTED (1st CASE)	.806201E-01	.1456E-01	5.537	(.00000)
AVE BIRTH WT--CHLDRN	.943520E-01	.1991E-01	4.739	(.00000)
AVE FREQ OF RESP ILL-CHLDRN	-.810000E-02	.1901E-01	-.426	(.67010)
AVE RESP ILL EPSD-CHLDRN	-.934075E-02	.7466E-02	-1.251	(.21089)
AVE GASTRO ILL EPSD-CHLDRN	.469834E-02	.1565E-01	.300	(.76409)
NO. OF CHILDREN W/ SKIN ILL	.386188E-02	.1175E-01	.329	(.74234)
AVE SKIN ILL EPSD-CHLDRN	-.743743E-02	.3616E-02	-2.057	(.03970)
NO HHMEM INFCTD W/ CT ILL-OTHERS	.598170E-01	.4499E-01	1.330	(.18368)
AVE CT ILL EPSD-OTHERS	.902978E-03	.1006E-01	.090	(.92848)
AVE FREQ OF CT ILL-CHLDRN	.506006E-02	.2228E-01	.227	(.82032)
AVE FREQ OF CT ILL-OTHERS	-.153032	.5263E-01	-2.907	(.00364)
AVE CT ILL EPSD-CHLDRN	.892611E-02	.1011E-01	.883	(.37735)
NO OF CHLDRN; HOME REL ACCIDENT	.123080	.6197E-01	1.986	(.04701)
HHTYPE	-1.62088	.2587	-6.267	(.00000)
CITY	.548781E-01	.1420	.387	(.69906)

Frequencies of actual vs. predicted outcomes
Predicted outcome has the highest probability.

		Predicted	
Actual	TOTAL	0	1
TOTAL	1971	19	1952
0	399	11	388
1	1572	8	1564

Table 2

Dependent Variable.....	OWN VALUATION OF HH HEALTH--CHLDRN
Log-Likelihood.....	-946.Ø3
Restricted (Slopes=Ø) Log-L.	-1Ø71.1
Chi-Squared (17).....	250.Ø5
Significance Level.....	.32173E-13

Variable	Coefficient	Std. Error	T-ratio	(Sig. Lvl)
INTERCEPT	.554Ø8Ø	.2446	2.265	(.Ø2351)
AVE BIRTH WT --CHLDRN	.459759E-Ø1	.1993E-Ø1	2.3Ø7	(.Ø2Ø6)
EXTENT OF DISABILITY	.114385	.8450E-Ø1	1.354	(.17585)
NO OF CHLDRN RESP ILL (1ST CASE)	.487942E-Ø1	.3904E-Ø1	1.25Ø	(.21137)
AVE FREQ OF RESP ILL --CHLDRN	-.384917E-Ø1	.3656E-Ø1	-1.Ø53	(.29241)
AVE RESP ILL EPSD	-.219383E-Ø4	.8956E-Ø2	-.ØØ2	(.99805)
NO OF CHLDRN W/ GASTRO ILL	-.224291	.9Ø55E-Ø1	-2.477	(.Ø1325)
AVE FREQ OF GASTRO ILL --CHLDRN	-.16Ø932E-Ø1	.3243E-Ø1	-.496	(.61967)
AVE GASTRO ILL EPSD--CHLDRN	.118313E-Ø1	.1686E-Ø1	-.7Ø2	(.48277)
NO OF CHLDRN W/ SKN ILL-CHLDRN	.51Ø229E-Ø1	.1Ø24	.498	(.61838)
AVE FREQ OF SKN ILL-CHLDRN	.567329E-Ø2	.1134E-Ø1	.5ØØ	(.61692)
AVE SKN ILL EPSD--CHLDRN	-.497583E-Ø2	.4886E-Ø2	-1.Ø18	(.3Ø852)
AVE FREQ OF CT ILL-OTHERS	-.155ØØ4	.9322E-Ø1	-1.663	(.Ø9638)
AVE FREQ OF CT ILL-CHLDRN	-.123Ø33	.4511E-Ø1	-2.728	(.ØØ638)
AVE CT ILL EPSD--CHLDRN	-.396570E-Ø1	.1180E-Ø1	-3.36Ø	(.ØØØ78)
NO OF CHLDRN W/ DISABILITIES	-.242320	.1106	-2.19Ø	(.Ø2851)
HHTYPE	-1.27767	.1385	-9.228	(.ØØØØØ)
CITY	-.345425	.1353	-2.554	(.Ø1Ø66)

Frequencies of actual vs. predicted outcomes.
Predicted outcome has the highest probability.

		Predicted	
Actual	TOTAL	Ø	1
TOTAL	2ØØ4	1822	182
Ø	1551	1469	82
1	453	353	1ØØ

This may be taken to mean that respondents from urban poor communities consistently gave lower health ratings for their own households.

Among the variables used to stand for the various dimensions of household health, only the manner in which illness was contracted, the average birth weight of children, length of illness episode of skin ailments, number of household members reported to have been stricken with some type of contagious disease, the number of times household members were afflicted with a contagious disease in the last three months, and the number of children who had home related accidents are found to be statistically significant health concerns.

Two anomalous results need to be explained. Contrary to expectations, the number of household members who had a contagious disease and the number of children who had home related accidents are positively correlated with household health status. A possible explanation for these results has to do with health awareness and recall. There is a tendency for healthier households to be more aware or conscious of the state of health of its members. It could very well be that those who vividly remembered incidence of contagious illness and accidents come from healthier families. Hence, statistically, a positive relationship is observed.

Regarding the health status index for children, birth weight, extent of debility due to illness, physical disabilities, and incidence of gastro-intestinal, respiratory and skin diseases are revealed to be the more important concerns that went into respondent valuation.

Respondents from urban poor communities are also revealed to have given lower ratings on the state of health of their children. Furthermore, respondents from Cebu have judged their children as having poorer health.

B. Housing Condition Indices

Between respondent valuation and enumerator judgement, the former is found more consistent with objective measures of specific housing and environmental characteristics. Only regression results using respondent valuation as the dependent variable are presented here (see Tables 3 and 4).

The age of the housing structure is found to be statistically significant and is determined to be inversely related to overall housing condition. The quality of roofing material is also found to be a significant factor. However, flooring and walling materials are determined to be weak determinants of housing condition.

Table 3

ORDINARY LEAST SQUARES ESTIMATES

Dependent Variable.....	AVE RATING OF SLCTD HSING CHRCTRSTCS
Number of Observations....	1678
Mean of Dependent Variable.	3.36644
Std. Dev. of Dep. Variable.	.87247
Std. Error of Regression...	.67820
Sum of Squared Residuals...	764.43
R - Squared.....	.40116
Adjusted R - Squared.....	.39576
F-Statistics (15, 1662)...	74.22518
Significance of F-Test.....	.00000
Log-Likelihood.....	-1721.4
Restricted (Slopes=0) Log-L	-2151.5
Chi-Squared (15).....	860.34
Significance Level.....	.32173E-13
Durbin - Watson Statistics.	1.3609
Estimated Autocorrelation (Rho)	.31956

Variable	Coefficient	Std. Error	T-ratio	(Sig. Lvl)
INTERCEPT	2.43164	.1535	15.838	(.00000)
AGE OF HOUSING STRUCTURE	-.509938E-02	.1719E-02	-2.966	(.00321)
TYPE OF TOILET FACILITY	.113077	.1825E-01	6.198	(.00000)
INTERIOR SPACE/HHMEM	.511499E-02	.1773E-02	2.885	(.00408)
SOURCE OF DRINKING WATER	-.5033913E-01	.1219E-01	-4.132	(.00007)
TYPE OF ROOFING MATERIAL	.491779E-01	.2149E-01	2.288	(.02111)
TYPE OF FLOORING MATERIAL	.195896E-01	.2116E-01	.926	(.35777)
TYPE OF EXTERIOR WALL MATERIAL	.181038E-01	.1480E-01	1.224	(.21883)
TYPE OF WINDOW	-.248805E-01	.2061E-01	-1.207	(.22519)
PRESENCE OF GARBAGE	.973326E-01	.4090E-01	2.380	(.01663)
PRSNCE OF HMN & ANML WASTE	.191655	.2162E-01	8.863	(.00000)
CNDITN OF SEWERS--NEIGHBHD	-.158270E-01	.1502E-01	-1.054	(.29247)
PRESENCE OF STAGNANT WATER	.287648	.3881E-01	7.411	(.00000)
PRESENCE OF PESTS	-.322470E-01	.1300E-01	-2.480	(.01275)
HHYTPE	-.177679	.6572E-01	-2.704	(.00688)
CITY	-.223359	.4039E-01	-5.530	(.00000)
Sigma	.678195	.1171E-01	57.931	(.00000)

Table 4

ORDINARY LEAST SQUARES ESTIMATES

Dependent Variable.....	AVE RATING OF SLCTD HSNG CHRCTRSTC
Number of Observations.....	1534
Mean of Dependent Variable..	3.38964
Std. Dev. of Dep. Variable..	.86283
Std. Error of Regression....	.66933
Sum of Squared Residuals....	680.07
R - Squared.....	.40411
Adjusted R - Squared.....	.39822
F -Statistic (15, 1518)....	68.62967
Significance of F -Test.....	.00000
Log-Likelihood.....	-1552.8
Restricted (Slopes=0) Log-L.	-1949.8
Chi-Squared (15).....	794.06
Significance Level.....	.32173E-13
Durbin - Watson Statistic...	1.3865
Estimated Autocorrelation (Rho)	.30674

Variable	Coefficient	Std. Error	T-ratio	(Sig. Lvl)
INTERCEPT	2.43007	.1594	15.242	(.00000)
AGE OF HOUSING STRUCTURE	-.331700E-02	.1810E-02	-1.833	(.06358)
TYPE OF TOILET FACILITY	.114213	.1855E-01	6.157	(.00000)
AVE LOT SIZE IN A BLOCK	.132046E-02	.3033E-03	4.353	(.00003)
SOURCE OF DRINKING WATER	-.505162E-01	.1259E-01	-4.014	(.00011)
TYPE OF ROOFING MATERIAL	.484681E-01	.2202E-01	2.202	(.02633)
TYPE OF FLOORING MATERIAL	.172916E-01	.2171E-01	.797	(.43148)
TYPE OF EXTERIOR WALL MATERIAL	.155551E-01	.1519E-01	1.024	(.30685)
TYPE OF WINDOW	-.283221E-01	.2133E-01	-1.328	(.18079)
PRESENCE OF GARBAGE	.102246	.4248E-01	2.407	(.01551)
PRSNCE OF HMN & ANML WASTE	.180476	.2260E-01	7.986	(.00000)
CNDTN OF SEWERS--NEIGHBRHD	-.120797E-01	.1538E-01	-.786	(.43810)
PRESENCE OF STAGNANT WATER	.273753	.3972E-01	6.892	(.00000)
PRESENCE OF PESTS	-.303574E-01	.1345E-01	-2.257	(.02286)
HHTYPE	-.129377	.7071E-01	-1.830	(.06403)
CITY	-.247282	.4250E-01	-5.819	(.00000)
Sigma	.669332	.1208E-01	55.390	(.00000)

As expected, the type of toilet facility is shown to be an important factor. But kitchen and bathing facilities are shown to have weak determinations.

Among the variables on the home environment, only the condition of sewers did not significantly affect respondent scoring. The presence of garbage within 20 meters of the dwelling, the presence of human and animal waste, the presence of pests are found to have significant influences on the scores.

The estimated partial regression coefficient for the dummy on household type reveals that urban poor respondents gave lower ratings for their dwellings. This result dispels apprehensions that the poor might consider their housing condition adequate when, by nonpoor standards, it would be considered substandard. In other words, the result suggests that scores made by the urban poor are comparable with those made by the nonpoor.

The model referred to in Table 3 uses housing congestion as the measure of living space, while the one referred to in Table 4 uses housing density. While the former measure deals with the amount of living space available to the household and the latter refers to what is available to the community or neighborhood, both are highly interrelated. People living in low density areas tend to have spacious houses, while those living in high density communities tend have less room. Hence, the two variables are used in separate models.

The results in Table 3 suggest that those with more living space per household member have better housing conditions as well. Expectedly, those living in low density neighborhoods have better-maintained homes.

C. Determination of Household Health

Housing is found to significantly influence household health (see Table 5 for the determination of overall household health status and Table 6 for the determination of the health status of children). The housing condition index based on enumerator valuation and that based on respondent valuation were used in alternative specifications of the model. The trial runs confirmed doubts expressed earlier regarding the biases of enumerator ratings. Only the respondent-valuation-based housing index was found to be statistically significant in determining household health status.

The dummy for household type is included in the specification. This time it is used to test for the overall health effect of having to reside in an urban poor community. The dummy is found to be statistically significant. This might be taken to mean that having to live in an urban poor community exposes the household to various health problems.

Table 5

ORDINARY LEAST SQUARES ESTIMATES

Dependent Variable.....	HH HEALTH STATUS—ADULT
Number of Observations.....	1531
Mean of Dependent Variable.	.78372
Std. Dev. of Dep. Variable.	.15962
Std. Error of Regression...	.13054
Sum of Squared Residuals...	25.798
R - Squared.....	.33817
Adjusted R - Squared.....	.33118
F-Statistic (16, 1514)....	48.34989
Significance of F-Test.....	.00000
Log-Likelihood.....	953.38
Restricted (Slopes=0) Log-L.	637.47
Chi-Squared (16).....	631.82
Significance Level.....	.32173E-13
Durbin - Watson Statistic..	1.7568
Estimated Autocorrelation (Rho)	.12161

Variable	Coefficient	Std. Error	T-Ratio	(Sig. Lvl)
INTERCEPT	.734735	.3991E-01	18.408	(.00000)
HHTYPE	-.108165	.1270E-01	-8.517	(.00000)
AVE AGE--HHHEAD & SPOUSE	.635431E-03	.4249E-03	1.496	(.13065)
AVE YRS SCHLNG—HHHEAD & SPOUSE	-.749845E-04	.1310E-02	-.057	(.90905)
EMPLOYMENT STATUS—SPOUSE	-.254679E-02	.6528E-02	-.390	(.69755)
FOOD EXPENDITURE/HHMEN	-.185435E-04	.1697E-04	-1.093	(.27410)
MED EXPNDTRS—DEATHS REPORTED	-.120429E-05	.1227E-05	-.982	(.32809)
MED EXPNDTRS—ILL REPORTED	.468417E-05	.4995E-05	.938	(.35123)
AVE WT-CHLDRN AT BIRTH	.166457E-0	.1175E-02	14.170	(.00000)
AVE VACCINATION—CHLDRN	.139776E-02	.1789E-02	.781	(.44075)
DSBLTIES—MED CARE/SPRVSN	-.458891E-02	.1044E-01	-.440	(.66401)
RESP ILL—MED TREATMENT	.797513E-02	.4774E-02	1.671	(.09087)
GASTRO ILL—MED TREATMENT	-.271805E-02	.5339E-02	-.509	(.61700)
SKIN ILL—MED TREATMENT	-.125018E-01	.9673E-02	-1.292	(.19317)
CT ILL-MED TREATMENT	.161180E-02	.5075E-02	.318	(.74618)
AVE RATING HSNG CHRCTRSTCS	.195098E-01	.9104E-02	2.143	(.03048)
BARANGAY HEALTH UNIT	-.118168E-01	.7308E-02	-1.617	(.10181)
Sigma	.130537	.2359E-02	55.335	(.00000)

Table 6

ORDINARY LEAST SQUARES ESTIMATES

Dependent Variable.....	HH HEALTH STATUS—CHLDRN
Number of Observations.....	1531
Mean of Dependent Variable..	.22412
Std. Dev. of Dep. Variable..	.15461
Std. Error of Regression....	.07938
Sum of Squared Residuals....	9.5395
R - Squared.....	.73917
Adjusted R - Squared.....	.73642
F-Statistic (16, 1514).....	268.16121
Significance of F-Test.....	.00000
Log-Likelihood.....	1714.9
Restricted (Slopes=0) Log-L.	686.25
Chi-Squared (16).....	2057.4
Significance Level.....	.32173E-13
Durbin - Watson Statistic...	1.6474
Estimated Autocorrelation (Rho)	.17630

Variable	Coefficient	Std. Error	T-ratio	(Sig. Lvl)
INTERCEPT	.335231	.2427E-01	13.812	(.00000)
HHTYPE	-.267313	.7723E-02	-34.613	(.00000)
AVE AGE—HHHEAD & SPOUSE	.401616E-03	.2584E-03	1.555	(.11592)
AVE YRS SCHLNG—HHHEAD & SPOUSE	.124549E-02	.7967E-03	1.563	(.11383)
EMPLOYMENT STATUS—SPOUSE	.181409E-02	.3969E-02	.457	(.65226)
FOOD EXPENDITURE/HHMEN	.186537E-04	.1032E-04	1.808	(.06720)
MED EXPNDTRS—DEATHS REPORTED	.170735E-05	.7459E-06	2.289	(.02107)
MED EXPNDTRS--ILL REPORTED	.133973E-05	.3037E-05	.441	(.66308)
AVE WT OF CHLDRN AT BIRTH	.853765E-02	.7143E-03	11.952	(.00000)
AVE VACCINATION--CHLDRN	.988503E-03	.1088E-02	.908	(.36711)
DSBLTS—MED CARE/SPRVSN	-.168284E-01	.6346E-02	-2.652	(.00796)
RESP ILL--MED TREATMENT	.120600E-02	.2903E-02	.415	(.68045)
GASTRO ILL—MED TREATMENT	-.195032E-01	.3247E-02	-6.007	(.00000)
SKIN ILL--MED TREATMENT	-.128200E-01	.5882E-02	-2.179	(.02783)
CT ILL—MED TREATMENT	-.265608E-01	.3086E-02	-8.607	(.00000)
AVE RATING HSNG CHRCTRSTCS	.215958E-01	.5536E-02	3.901	(.00016)
BARANGAY HEALTH UNIT	-.392466E-02	.4444E-02	-.883	(.38117)
Sigma	.793778E-01	.1434E-02	55.335	(.00000)

* Health is part of what the household sacrifices to avail of affordable and accessible (with respect to workplace) accommodations.

Contrary to demographic and epidemiological expectations, age and health status are positively related. This validates the alternative hypothesis that because the age of the household head and spouse are positively correlated with income, households with older breadwinners tend to be healthier.

Schooling, the employment status of the mother, food expenditures, and average medical expenditures for health problems are found to be statistically insignificant determinants of household health.

Among the variables used to capture the application of medical attention, only household health problems on respiratory and skin diseases of children are found statistically significant.

The presence of an active barangay health center in the community is found to be an important determinant of household health. The negative sign of the estimated partial regression coefficient, however, implies that the active presence of a health center in the community has a positive effect on household health. The variable in question takes on a value to one if the respondent confirms the existence of an active health unit, and two, otherwise.

The dummy for the type of urban community is found to be statistically significant. The results imply that children of families living in urban poor communities are less healthy because they are more exposed to housing and environmentally related health hazards. Similarly, the housing condition index is also found to be an important determinant of children's health status.

The average age of breadwinner and spouse, and their average number of years of schooling are found to be significantly and positively related to children's health. Once more, household income tend to increase with age (perhaps at a diminishing rate) and income, in turn, sets the limit on the amount of health inputs a household utilizes to improve on its physical and social well-being. Schooling, on the other hand, does not only determine capacity to generate income, but also measures the amount and quality of health-related information that goes into child care.

However, the dummy variable on mother's employment status still remains a weak determinant of health. This result suggests that whether a mother is employed or not is not important as far as the health status of children are concerned. It could very well be that the additional income

the mother generates through employment is just sufficient to pay for services that substitute for what she could have provided herself.

D. The Health Effects of Specific Housing Characteristics

In determining the health effects of specific housing and environmental characteristics, the estimated indices for overall household and children's health status are regressed against the same variables used to establish the housing condition index. Table 7 presents the result for overall household health while Table 8 presents that for the health status of children.

By comparing the computed coefficient of multiple determination, it seems that on the whole, housing has a stronger effect on children's health. The model for children explains as much as 40 percent of variations of the health index, while that for the entire household explains only as much as seven percent.

Among the housing characteristics found to be statistically significant in determining the state of health of the entire household are housing congestion, quality of roofing material, flooring material, presence of human and animal waste in the home environment, presence of stagnant water and the quality of sewers.

Other than the roof and floor, the housing components found to matter the most as far as health is concerned are public good types. This result has important policy implications. If one were concerned with the health of the urban poor, resources should then be allocated for the provision of facilities or services that a single household would not and cannot provide for itself.

The health status of children is determined to be significantly influenced by such housing components as housing congestion, source of drinking water, quality of roofing and flooring, type of windows, human and household waste disposal, sewers, and the presence of pests.

The results validate the hypothesis that children, being more exposed in terms of time and activity, are more sensitive to the health hazards of the home environment.

Finally, after comparing the above results with the estimates of the implicit prices of specific housing attributes (see Table 9), one concludes that housing components that matter most as far as health is concerned may not be equally valued by the market.

The estimated intercept, for example, may be interpreted as the rental value of housing realized regardless of structure,

Table 7

ORDINARY LEAST SQUARES ESTIMATES

Dependent Variable.....	HH HEALTH STATUS--ADULT
Number of Observations.....	1731
Mean of Dependent Variable.	.77718
Std. Dev. Dep. Variable....	.17500
Std. Error of Regression...	.16863
Sum of Squared Residuals...	48.827
R - Squared.....	.07838
Adjusted R - Squared.....	.07140
F-Statistic (13, 1717)....	11.23259
Significance of F-Test.....	.00000
Log-Likelihood.....	632.04
Restricted (Slopes=0) Log-L.	561.42
Chi-Squared (13).....	141.23
Significance of Level.....	.32173E-13
Durbin - Watson Statistic..	1.3530
Estimated Autocorrelation (Rho)	.32351

Variable	Coefficient	Std. Error	T-ratio	(Sig. Lvl)
INTERCEPT	.660419	.3124E-01	21.138	(.00000)
AGE OF HOUSING STRUCTURE	.503086E-04	.4179E-03	.120	(.87135)
TYPE OF TOILET FACILITY	-.118667E-02	.4384E-02	-.271	(.77708)
INTERIOR SPACE/HHMEN	.105374E-02	.3996E-03	2.637	(.00829)
SOURCE OF DRINKING WATER	-.205408E-02	.2800E-02	-.734	(.46997)
TYPE OF ROOFING MATERIAL	.147663E-01	.4963E-02	2.976	(.00312)
TYPE OF FLOORING MATERIAL	.160403E-01	.5068E-02	3.165	(.00176)
TYPE OF EXTERIOR WALL MATERIAL	.116677E-02	.3576E-02	.326	(.74044)
TYPE OF WINDOW	.514240E-02	.4883E-02	1.053	(.29275)
PRESENCE OF GARBAGE	-.142738E-02	.1003E-01	-.142	(.85807)
PRSNCE OF HMN & ANML WASTE	.850482E-02	.5201E-02	1.635	(.09797)
CNDTN OF SEWERS--NEIGHBRHD	-.765087E-02	.3628E-02	-2.109	(.03314)
PRESENCE OF STAGNANT WATER	.137450E-01	.9392E-02	1.463	(.13927)
PRESENCE OF PESTS	-.787149E-03	.3019E-02	-.261	(.78355)
Sigma	.168634	.2866E-02	58.839	(.00000)

Table 8

ORDINARY LEAST SQUARES ESTIMATES

Dependent Variable.....	HH HEALTH STATUS--CHLDRN
Number of Observations.....	1731
Mean of Dependent Variable.	.22347
Std. Dev. of Dep. Variable.	.15442
Std. Error of Regression...	.11950
Sum of Squared Residuals...	24.518
R - Squared.....	.40564
Adjusted R - Squared.....	.40114
F-Statistic (13, 1717)....	90.14172
Significance of F-Test.....	.00000
Log-Likelihood.....	1228.3
Restricted (Slopes=0) Log-L.	777.98
Chi-Squared (13).....	900.54
Significance Level.....	.32173E-13
Durbin - Watson Statistic..	1.1631
Estimated Autocorrelation (Rho)	.41843

Variable	Coefficient	Std. Error	T-ratio	(Sig. Lvl)
INTERCEPT	.363239E-01	.2214E-01	1.641	(.09682)
AGE OF HOUSING STRUCTURE	.400521E-03	.2962E-03	1.352	(.17269)
TYPE OF TOILET FACILITY	.935287E-03	.3107E-02	.301	(.75715)
INTERIOR SPACE/HHMEM	.304731E-02	.2832E-03	10.761	(.00000)
SOURCE OF DRINKING WATER	-.653539E-02	.1984E-02	-3.294	(.00118)
TYPE OF ROOFING MATERIAL	.125154E-01	.3517E-02	3.559	(.00050)
TYPE OF FLOORING MATERIAL	.176588E-01	.3591E-02	4.917	(.00000)
TYPE OF EXTERIOR WALL MATERIAL	.198418E-02	.2534E-02	.783	(.43968)
TYPE OF WINDOW	.271214E-01	.3460E-02	7.838	(.00000)
PRESENCE OF GARBAGE	.174509E-02	.7106E-02	.246	(.79335)
PRSNCE OF HMN & ANML WASTE	.904895E-02	.3686E-02	2.455	(.01362)
CNDTN OF SEWERS--NEIGHBRHD	-.297362E-02	.2571E-02	-1.157	(.24608)
PRESENCE OF STAGNANT WATER	.311958E-01	.6655E-02	4.687	(.00001)
PRESENCE OF PESTS	-.711382E-02	.2139E-02	-3.325	(.00107)
Sigma	.119498	.2031E-02	58.839	(.00000)

Table 9

ORDINARY LEASD SQUARES ESTIMATES

Dependent Variable.....	HOUSING EXPENDITURE
Number of Observations.....	438
Mean of Dependent Variable.	384.45662
Std. Dev. of Dep. Variable.	529.17446
Std. Error of Regression...	448.75338
Sum of Squared Residuals...	.85184E+08
R - Squared.....	.30389
Adjusted R - Squared.....	.28085
F-Statistic (14, 423).....	13.19031
Significance of F-Test.....	.00000
Log-Likelihood.....	-3288.6
Restricted (Slopes=0) Log-L	-3367.8
Chi-Squared (14).....	158.40
Significance Level.....	.32173E-13
Durbin - Watson Statistic..	1.9412
Estimated Autocorrelation (Rho)	.29415E-01

Variable	Coefficient	Std. Error	T-ratio	(Sig. Lvl)
INTERCEPT	462.888	217.0	2.133	(.03160)
AGE OF HOUSING STRUCTURE	-3.05335	2.232	-1.368	(.16828)
TYPE OF TOILET FACILITY	11.6404	23.84	.488	(.63121)
AVE LOT SIZE IN A BLOCK	-.624551	.2959	-2.111	(.03340)
SOURCE OF DRINKING WATER	15.5344	17.20	.903	(.37053)
TYPE OF ROOFING MATERIAL	-2.00262	27.07	-.074	(.89907)
TYPE OF FLOORING MATERIAL	70.4183	28.15	2.502	(.01227)
TYPE OF EXTERIOR WALL MATERIAL	6.51437	21.74	.300	(.75812)
TYPE OF WINDOW	85.2148	25.56	3.333	(.00109)
PRESENCE OF GARBAGE	17.5610	53.06	.331	(.73738)
PRSNCE OF HMN & ANML WASTE	16.8042	30.56	.550	(.58973)
CNDTN OF SEWERS--NEIGHBRHD	14.3027	21.57	.663	(.51495)
PRESENCE OF STAGNANT WATER	-79.8023	52.26	-1.527	(.12316)
PRESENCE OF PESTS	-42.6443	15.65	-2.726	(.00664)
HHTYPE	-405.024	83.81	-4.832	(.00001)
Sigma	448.753	15.16	29.597	(.00000)

facilities, and environment. This means that even if the dwelling was razed to the ground, the remaining space can still be rented out for ₱462 on the average. Tnis is 20 percent higher than the average total rental value of the sample.

The rest of the results may be similarly interpreted. On the average, the same house a year later will loose ₱3 in rental value. An additional house in a given block will reduce rental value by ₱0.62. Putting up better roofing will, on the average, raise the rent by ₱70. Better windows would fetch ₱85 higher. Finally, the same house built in an urban poor community would rent ₱405 less.

IV. CONCLUDING REMARKS

Housing is an important determinant of household health. As much as 40 percent of children's health status is determined by the various components of housing and environmental characteristics. The specific housing components found to have strong health effects are mostly of the public goods type. Furthermore, the housing attributes that are valued most in the market are not necessarily the same that matter most with respect to household health.

It has also been demonstrated here that a reliable health status index can be constructed based on respondent's subjective valuation. Results presented here suggest that respondents were sensitive to various aspects of morbidity, debility due to illness, and physical dysfunction. That subjective valuations were not able to capture mortality indicates that the index used underestimate the true state of health.

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